Magnetic Tracking Technology

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Magnetic Tracking, Briefly

transmitter broadcasts EM field

sensor and computer determine position and orientation

EM method has pros and cons that depend upon installation area

early use (1970) and still used for majority of motion capture applications

Overview

Uses

Technology

Strengths

Weaknesses

Products

Uses

For finding the orientation and position of a* real *object

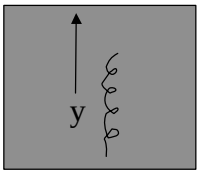
- six degrees of freedom (6-DOF) needed for 3-D interaction

commonly used for tracking head, hand, or input device

- can also be used for tracking joints, for full-body capture

Technology - Field Generation

transmitter is a coil with active current, which creates magnetic field

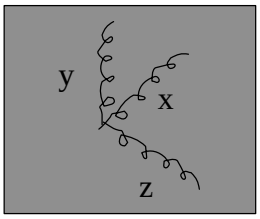


another coil senses magnetic field as current

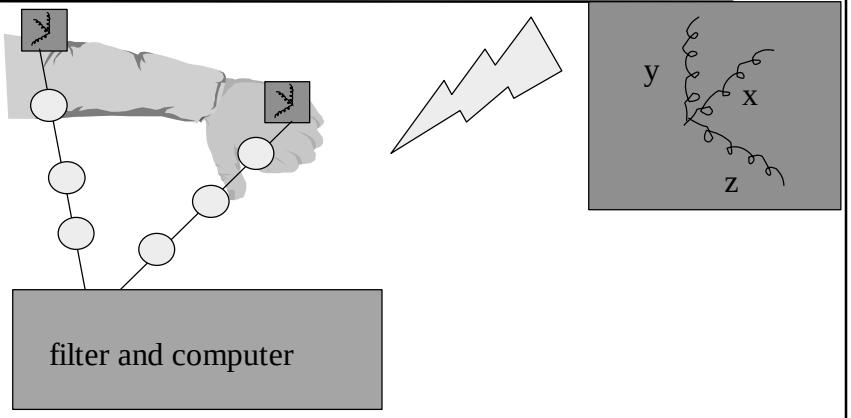
Technology - Field Generation

transmitter consists of three coils on orthogonal axes

current (AC or DC, depending on model) is passed through coils to generate field



Technology - System Diagram



Technology - Sensor

sensor also consists of similar coils

- sensor is passive, detects current only

additional computation device is needed to generate position and orientation

- complex combination of signal strengths
- also desire some filtering to reduce jitter
- all this processing causes latency

Strengths

no Line of Sight issues

generally inexpensive (more on this later)

reasonably accurate

can have large ranges-- large room size is possible

fairly high sample rate (120 Hz is common)

Weaknesses

field distortion

radio interference

accuracy diminishes with distance

computation and filtering causes latency

Weaknesses: Field Distortion

conductive metals cause eddy currents in EM field

- this affects the measurements resulting in distortion

AC fields cause eddy currents

- ferrous metals (carbon steel, iron) are even worse

to avoid distortion: map and compensate

Weaknesses: Field Distortion

newer DC field-generating transmitters offer an improvement

- DC fields reach a steady state, so can sample around eddy currents using timed pulses
- Ascension claims 3-10 times improvement with DC, both with conductive metals and ferrous metals
- no need for mapping/compensation method
- minimal setup means devices are portable

Weaknesses: Latency

delay greater than 60 msec between motion and feedback impairs presence

latency greater than 10 msec can cause simulator sickness

head movements can be as fast as 1,000 degrees/second in yaw

latency can be deadly to an application!

Products

Essentially there are two companies battling for supremacy:

- Polhemus
- Ascension

Both are located in Vermont! (Colchester and Burlington)

Note, pricing as of March 1996

Polhemus

founded in 1970

subsidiary of Kaiser Aerospace & Electronics

initially developed trackers for military applications

now claims 70% of the motion capture market

Polhemus Fasttrak

- latency 4 msec unfiltered
- volume 10-30 feet
- LongRanger extends to high end, but only accurate to 15'
- 120 Hz sample rate
  - but divided amongst receivers
- AC field, serial port interface

$ 6000

Ascension Technology Corp.

founded in 1986

makes motion tracking technology only

broad market penetration, from high-end to commodity market

Ascension Flock of Birds

- latency 7.5 msec unfiltered
- 144 Hz sample rate
  - multiple sensors do not reduce sample rate
- DC field
- volume 3-8 feet (this is a more realistic number than Polhemus gives)

$ 2700

Ascension SpacePad

low cost system meant for VE game developers

- 120 Hz sample rate
- accuracy and resolution less important than update rate and lag
- antenna configuration done by user, so large tracking volumes are possible

$ 1000 w/ PC card

References

Ascension Technology Corp.

- http://www.ascension-tech.com

Polhemus

- http://www.polhemus.com

Review of Virtual Environment Interface Technology:

- http://www.hitl.washington/edu/scivw/IDA